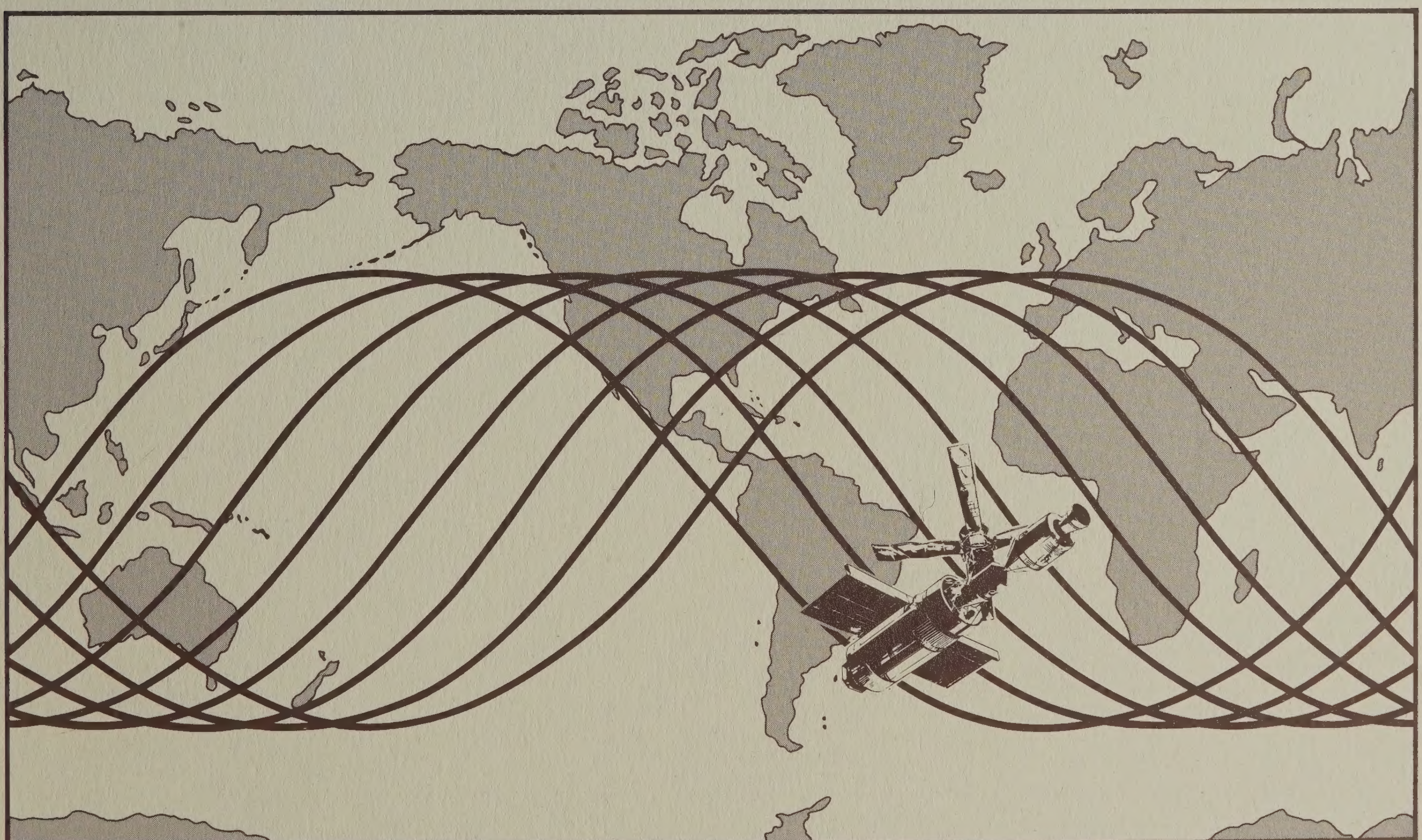
Skylab

INFORMATION GUIDE



MCDONNELL DOUGLAS CORPORATION

From May 7, 1973

C. W. HUTTON

To: Mr. Lawrence C. Jolivet

Dear Joly:

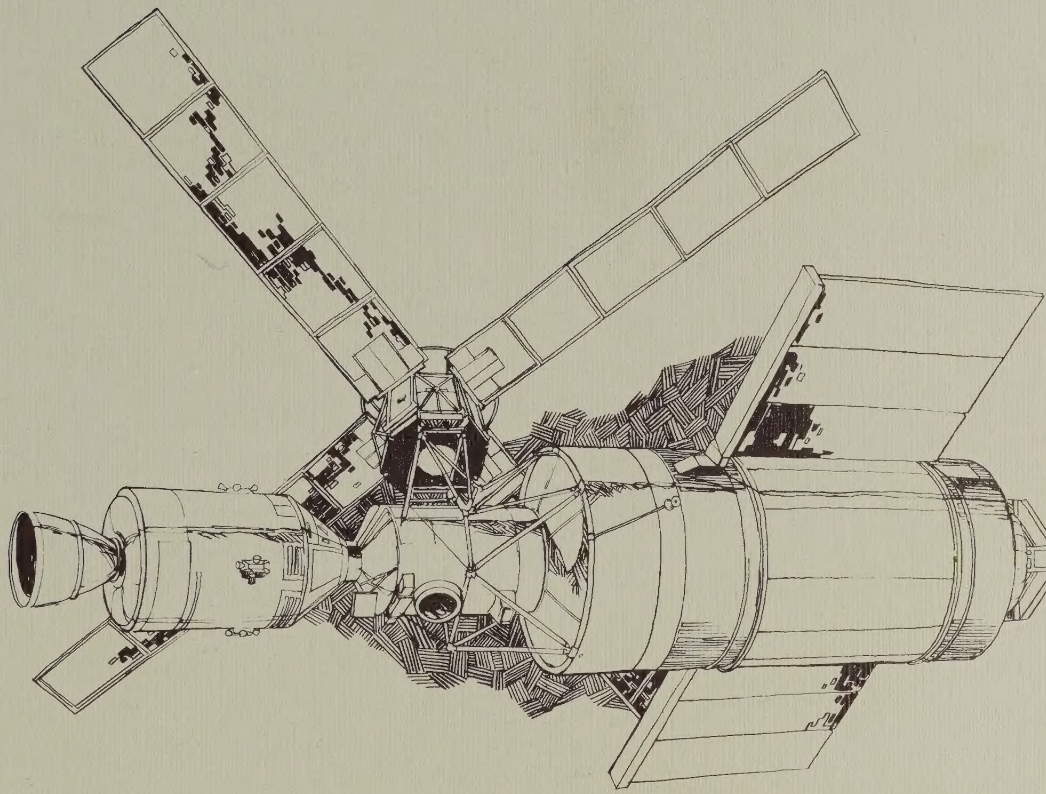
Skylab is currently planned to be launched at 1:30 p.m. from Cape Kennedy on Monday, May 14, 1973. If all goes well, this event will be well publicized and I am sure the attached booklet will give you a better understanding as to what it is all about. We have enjoyed working on this program for the last eight or nine years...and we are looking forward to a successful and a very useful mission, one that will provide countless inputs that will extend our knowledge in many, many ways.

Warmest personal regards,

CHARLIE

Charles W. Hutton

THINK- VALUE IN PERFORMANCE



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Section 1
INTRODUCTION

Mercury, Gemini, and Apollo Missions were flown primarily to conduct basic space exploration and to substantiate the principle that man can survive and perform useful work in the space environment. In essence, both the missions and spacecraft formed the basis of operational experiments to advance man's knowledge of spaceflight. Capitalizing on this experience, Skylab is a well equipped research facility in which unique experimental and operational tasks will be performed in near-Earth orbit.

Scheduled for launch in 1973, Skylab will be the United States' first manned space station. This vehicle is capable of prolonged manned missions and it possesses numerous support facilities to undertake an integrated and multidisciplined experiment program. Skylab is designed for an orbital life of 240 days during which time one crew will visit for a 28 day period and two crews for a duration of 56 days each.

The Skylab program objectives are to study the Earth, the Sun, man and space technology. These investigations range from synoptic surveys of selected areas of the Earth and solar disc observations to determinations of physiological adaptation to the space environment and space effects on materials and processes. The Skylab and its missions have been designed to support a broad spectrum of research and operational objectives and to maximize the benefits and flexibility of man's presence in conducting advanced research tasks.

The experiments selected to achieve the Skylab program objectives can be categorized broadly into five groups: (1) Earth resources, (2) solar observations, (3) physical sciences, (4) life sciences, and (5) technology and operations. The experiments utilize unique opportunities available in Earth orbit which are not available for terrestrial investigations. For example:

- *A site above the atmosphere where observations of astronomical objects can be made free from the effects of the atmosphere.*
- *A vantage point from which synoptic, repeated and periodic views can be made of the Sun, the celestial sphere and the terrain below the Skylab.*
- *A zero-gravity environment.*
- *A boundless vacuum environment.*

The Skylab Student Project, which is a joint venture of the National Science Teachers Association and NASA, will also result in the conduct of experiments during the Skylab Missions. These experiments likewise will take advantage of the spectrum of Skylab's capabilities as a laboratory in Earth orbit.

The Skylab is outfitted and provisioned, including the installation of experimental appartus, on the ground, and is launched unmanned as a single payload (Figure 2-1). Later, the Apollo Command and Service Module is launched with the three-man crew by a Saturn IB vehicle. The module then rendezvous and docks with the Skylab to complete the Skylab assembly and to initiate the manned mission phases.

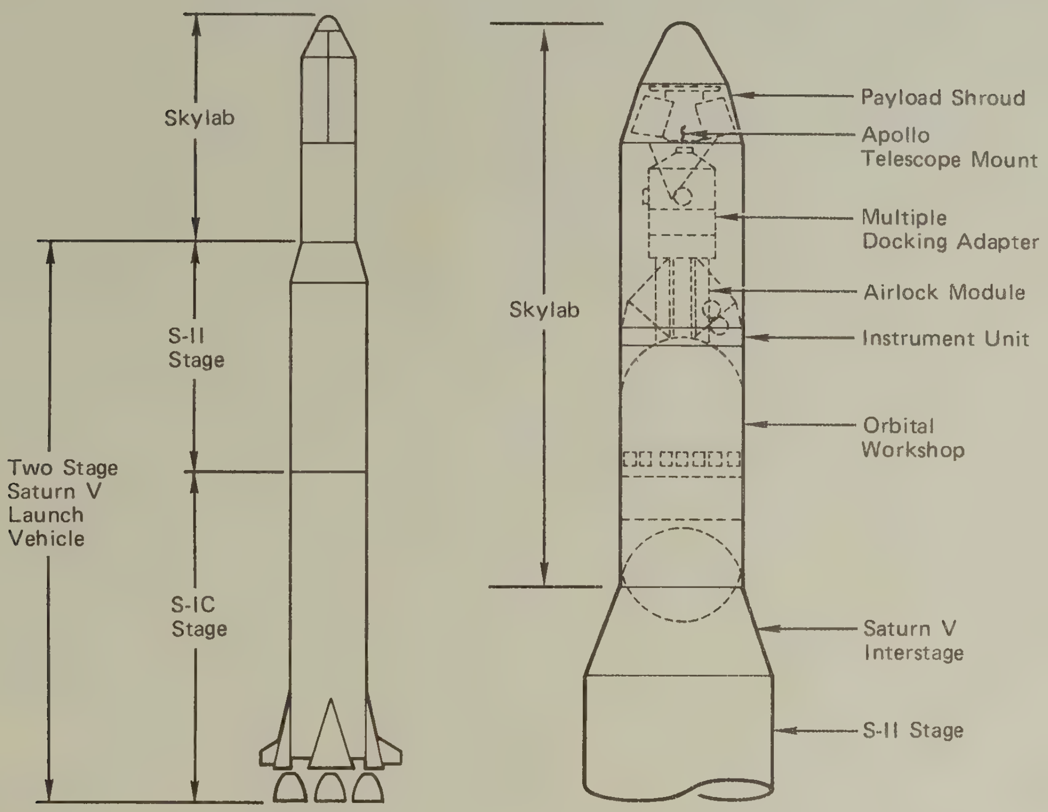


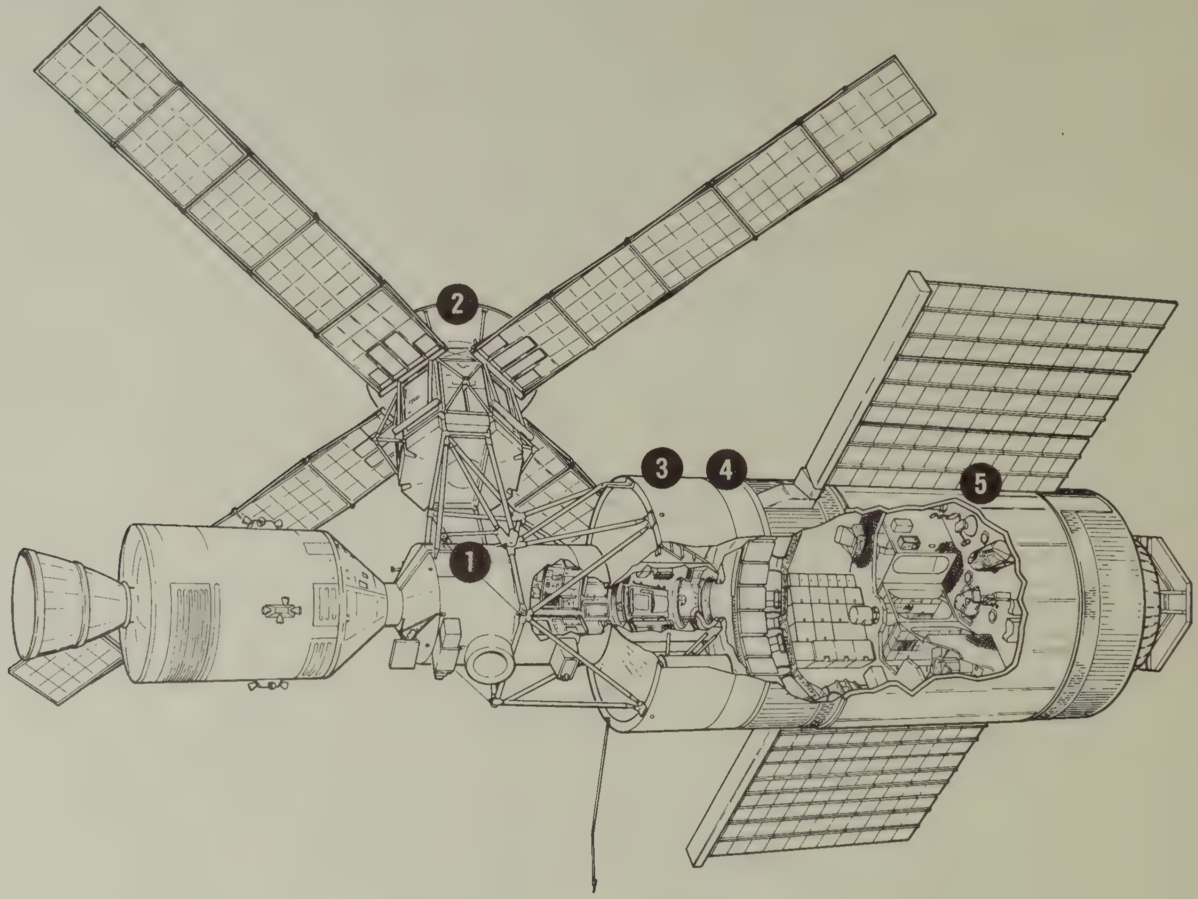
Figure 2-1. Skylab Launch Configuration

SKYLAB ORBITAL CONFIGURATION

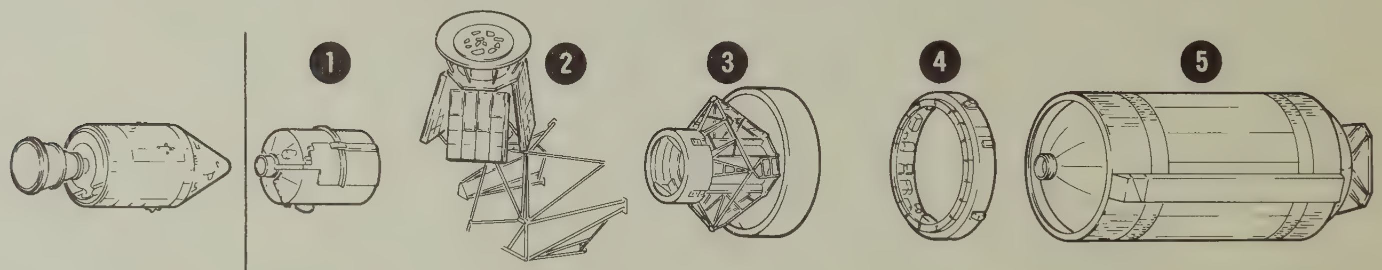
The Skylab, with the Apollo Command and Service Module docked for manned operations, is illustrated in Figure 2-2. The Skylab consists of five major elements. These elements are: (1) a Multiple Docking Adapter, which provides the docking interface for the Command and Service Module and supports the majority of the Earth resources experiments; (2) an Airlock Module, providing an airlock to space and controls for operational systems; (3) an Apollo Telescope Mount, containing the United States' first manned telescope in space; (4) an Orbital Workshop, containing crew quarters and substantial experiment facilities; and (5) a Saturn-V Instrument Unit, used only during launch and initial deployment. Experimental equipment has been appropriately located in each of the Skylab modules based on environmental and operational requirements.

Multiple Docking Adapter

The Multiple Docking Adapter provides the docking interface for the Apollo Command and Service Module with the Skylab. It permits the transfer of personnel, equipment, atmosphere, power and electrical signals between the docked Command and Service Module and the Skylab. Two docking ports are located on the Multiple Docking Adapter (Figure 2-3). The axial port is

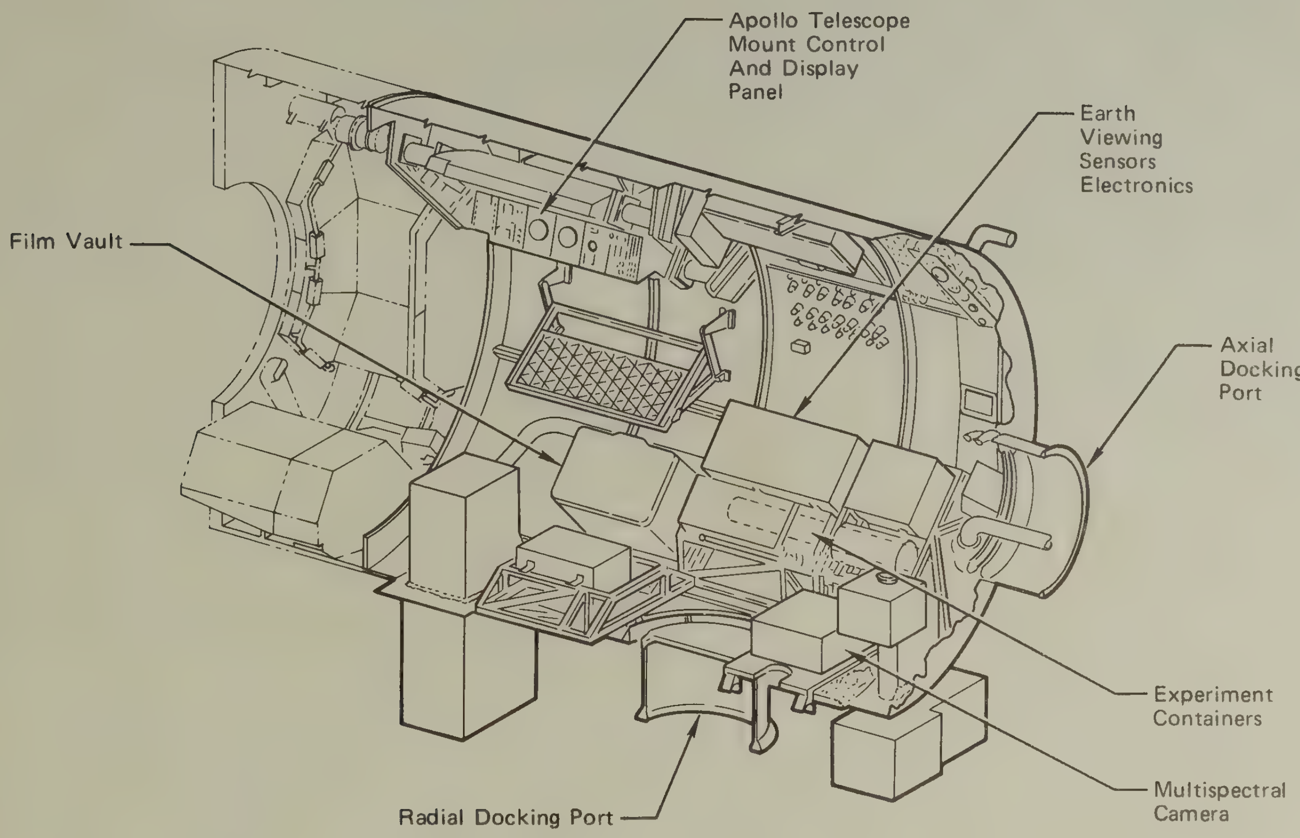


APOLLO | SKYLAB



	APOLLO	SKYLAB				
Element	Command and Service Module	Multiple Docking Adapter	Apollo Telescope Mount	Airlock Module/Fixed Airlock Shroud	Instrument Unit	Orbital Workshop
Function	Crew Ascent & Descent	Docking Interface Controls & Displays	Solar Observation	Power Control & Distribution Environmental Control Utility Center Data System Extravehicular Activity Port	Launch Vehicle Control	Primary Living & Working Area Experiment Laboratory Stowage
Length (ft)	34.5	17.5	13.5	17.5	3.0	48.0
Diameter (ft)	13.0	10.0	–	10.0	21.5	21.5
Working Volume (cu ft)	366	1,140	–	613	–	9,550

Figure 2-2. Skylab Elements



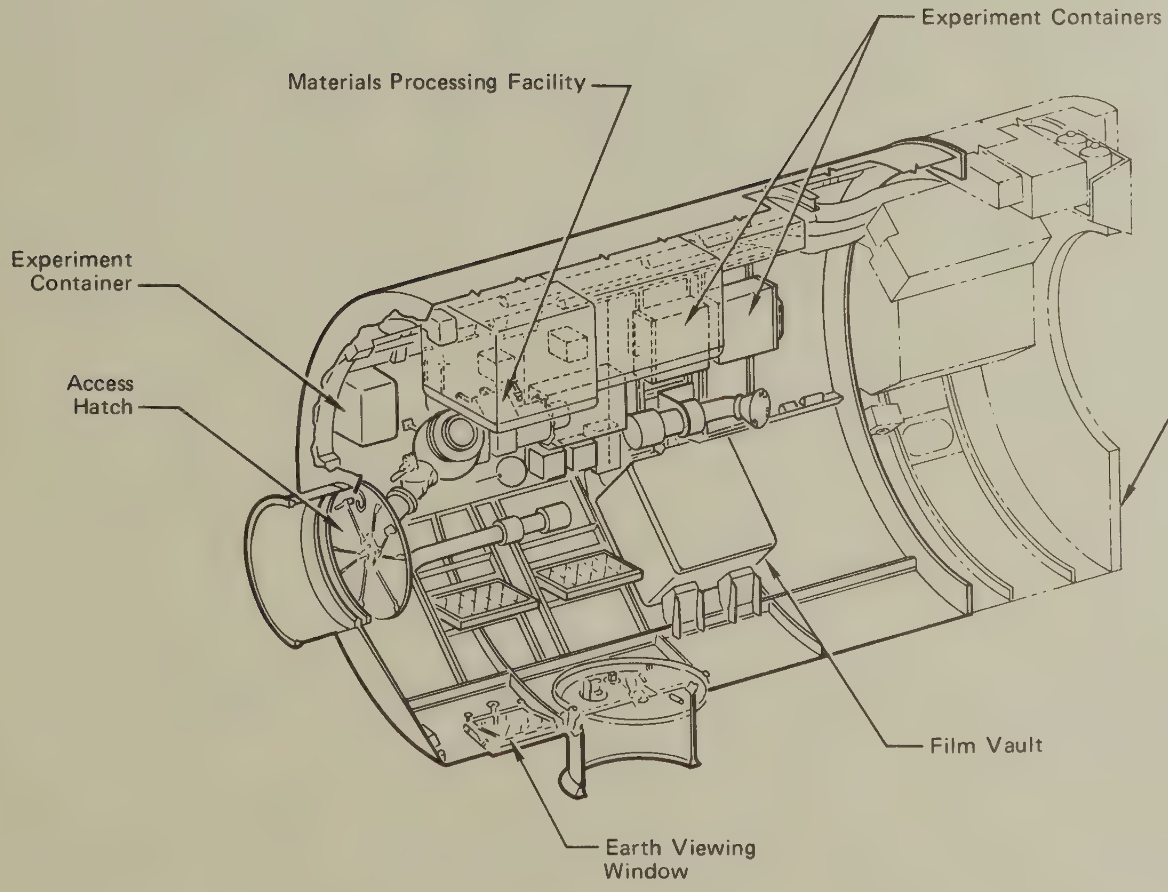


Figure 2-3. Multiple Docking Adapter

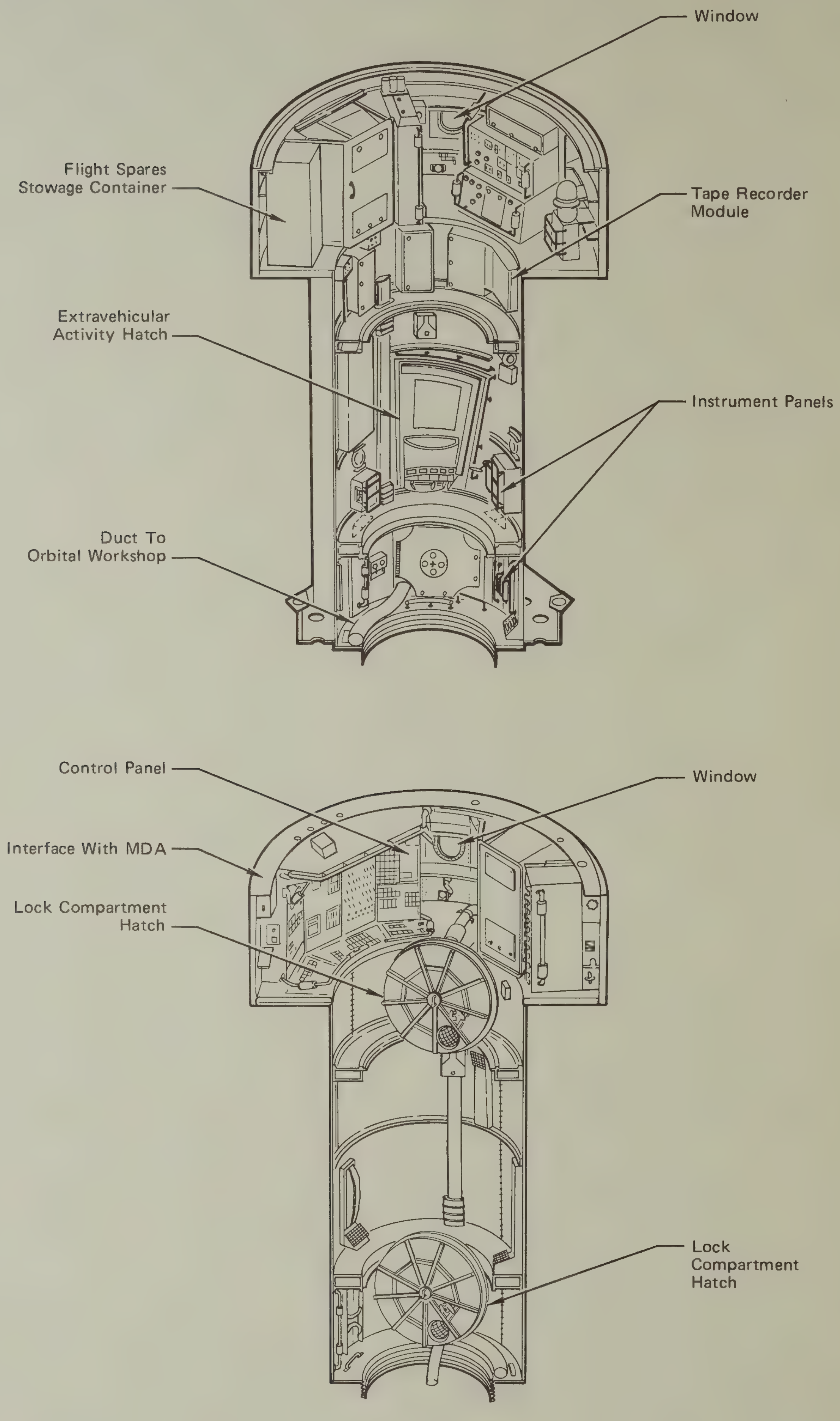


Figure 2-4. Airlock Module

equipped with complete support services for normal docking; the radial port, is provided for contingency only. The Multiple Docking Adapter contains control and display consoles for the Apollo Telescope Mount and the Earth Resources Experiment Package, and provisions for internal storage of hardware and experiments. Mounted externally are docking targets, running lights, and Earth viewing sensors.

Airlock Module

The Airlock Module, as the name implies, provides an airlock which allows the crew to perform extravehicular activities in space. The module also contains the control panels for electrical power distribution and controls for the atmosphere and thermal environment throughout the Skylab. The primary equipment for mission telecommunications, and data handling and recording are provided. The general arrangement of the Airlock Module, its components systems, and their relationship to the Skylab is shown in Figure 2-4.

Apollo Telescope Mount

The Apollo Telescope Mount is the United States' first manned solar observatory in space (Figure 2-5). It consists of an integrated set of eight telescopes to observe, monitor, and record the structure and behavior of the Sun and its corona. It includes guidance and navigation systems which provide attitude control and telescope alignment, and a solar array/battery system that supplies power to the Skylab.

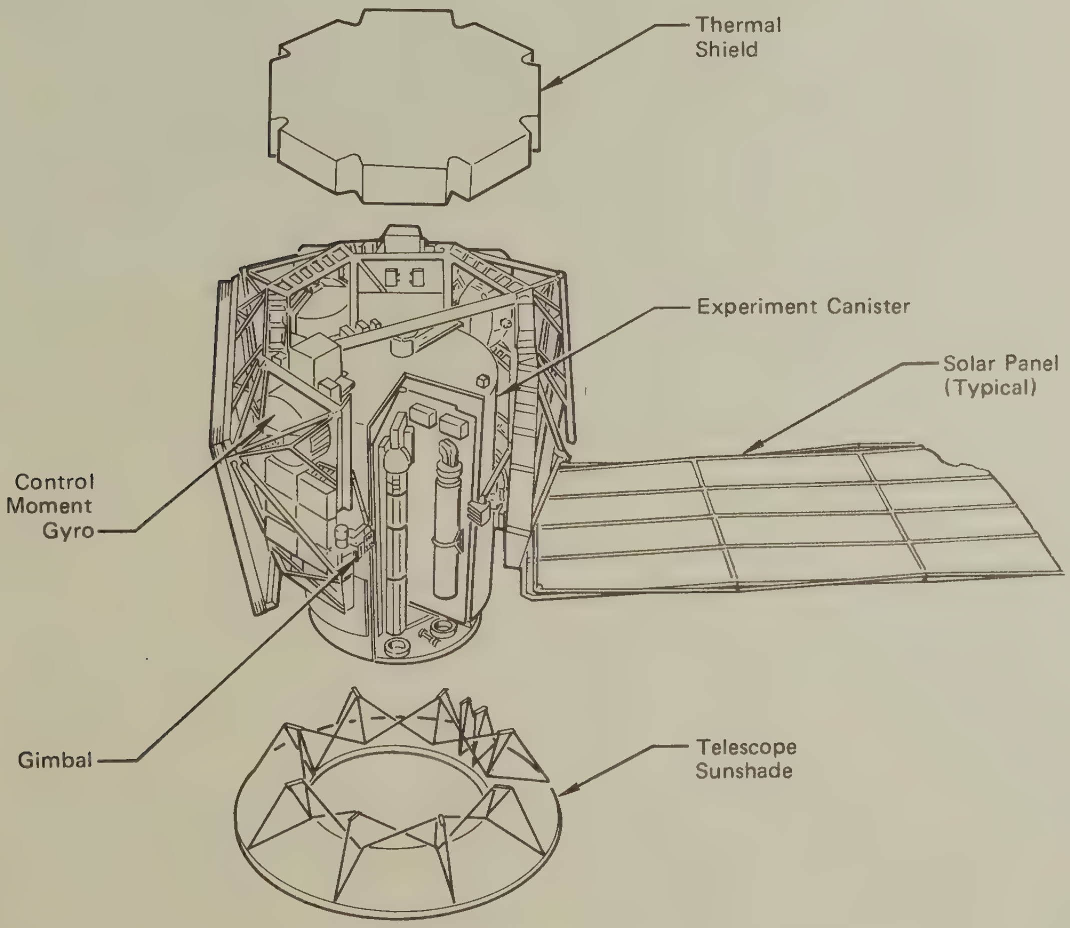


Figure 2-5. Apollo Telescope Mount Configuration

The control and display console for the Apollo Telescope Mount system is located in the Multiple Docking Adapter (Figure 2-3). From this console (Figure 2-6) the crewman can control the Apollo Telescope Mount experiments and observe solar activity in real-time. The control and viewing systems permit the crewman to select areas of special interest on the solar disc and to point the telescopes rapidly to observe transient phenomena. Figure 2-7 depicts the installation of the telescopes on the optical bench spar.

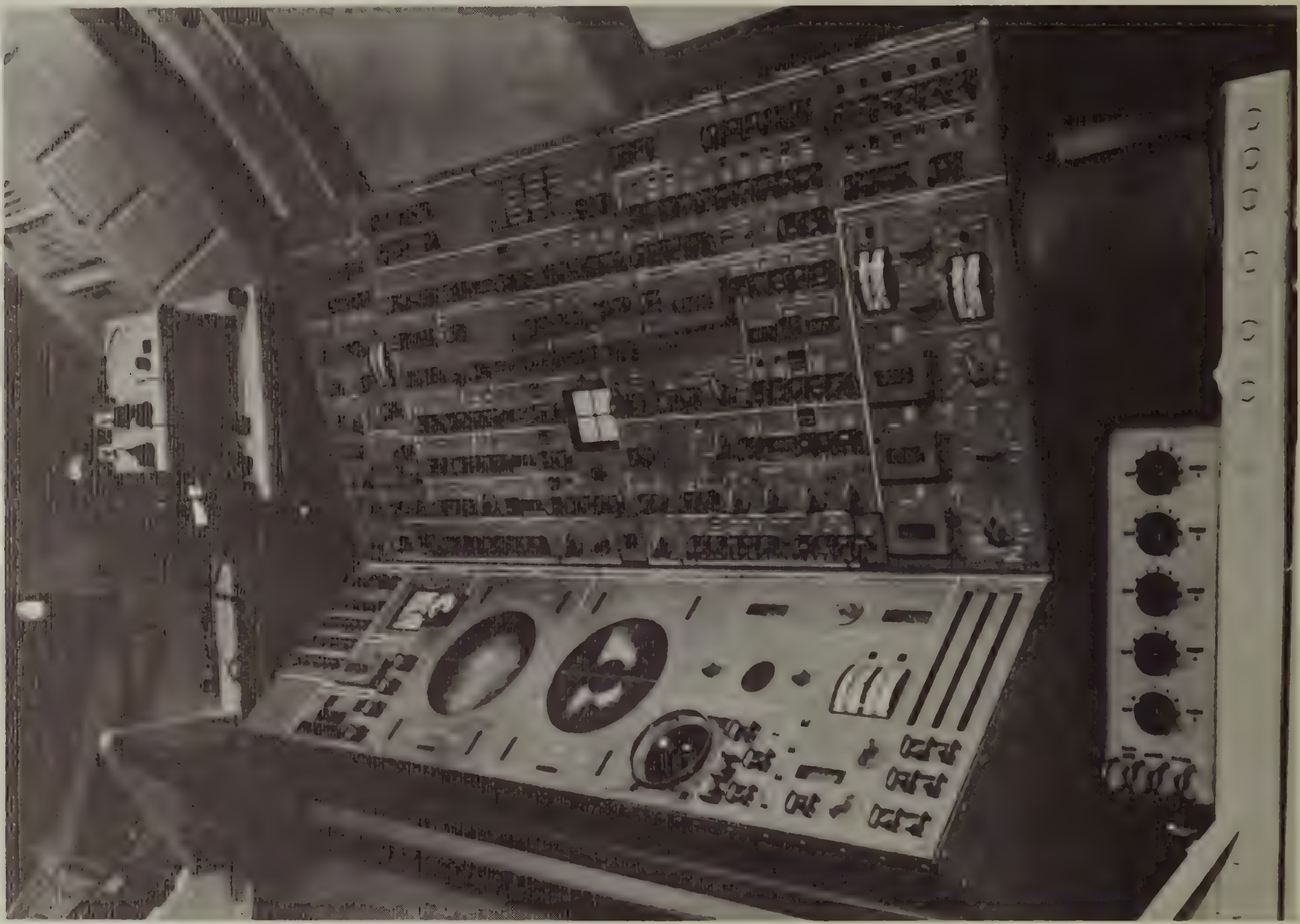


Figure 2-6. Apollo Telescope Mount Control and Display Panel

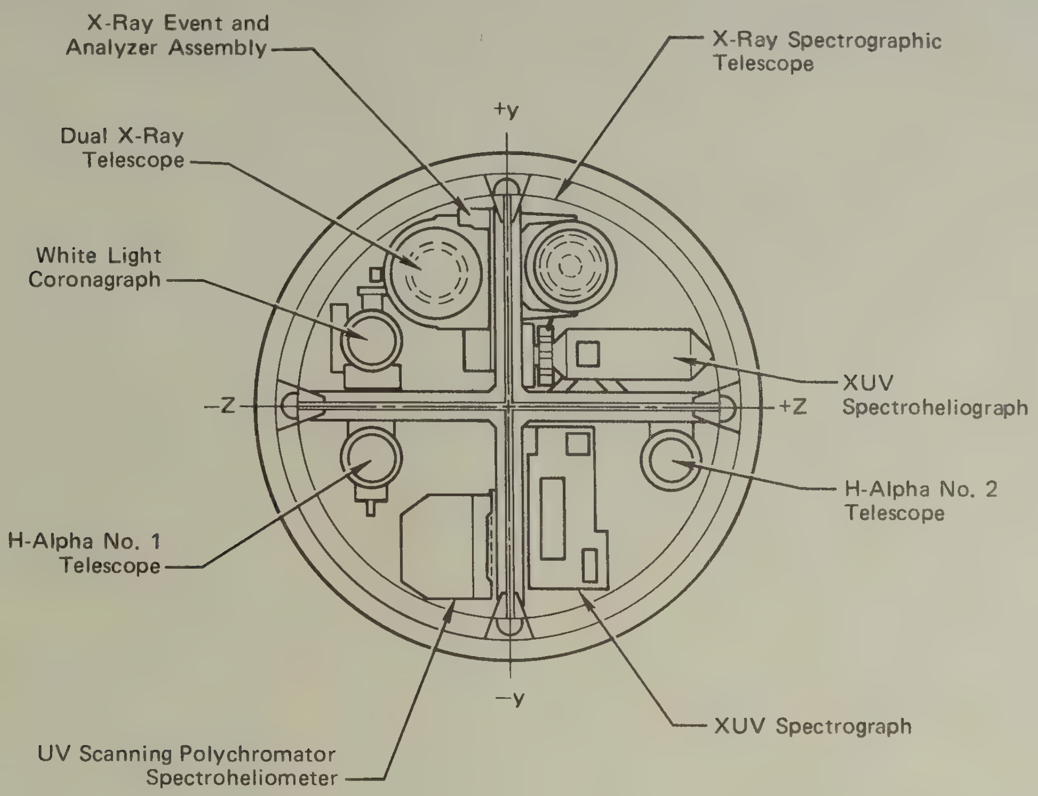


Figure 2-7. Telescope Installations

Orbital Workshop

The Orbital Workshop is a two-floor structure providing accommodations for the crew and a primary experiment area. The first floor is divided into four sections: the sleep compartment, the waste management compartment, the wardroom and the experiment work area. The biomedical experiments are performed in the experiment work area. The second floor is devoted primarily to experiments which require relatively large volumes or which utilize either of two scientific airlocks for external viewing or exposure. The remainder of the space is occupied by subsystems and storage compartments. These arrangements are shown in Figure 2-8.

The Workshop also is the storage area for crew supplies, such as food, water and clothing, as well as, providing for personal hygiene and waste and trash disposal.

Instrument Unit

The equipment and subsystems installed in the Instrument Unit are used only during launch and the first 7-1/2 hours of orbital operations. These subsystems provide launch vehicle guidance. Sequencing functions to deploy the Apollo Telescope Mount and its solar arrays, as well as the Workshop solar arrays, are also provided.

Experiments which can be mounted externally and do not require access by the crew can be installed in the Instrument Unit.

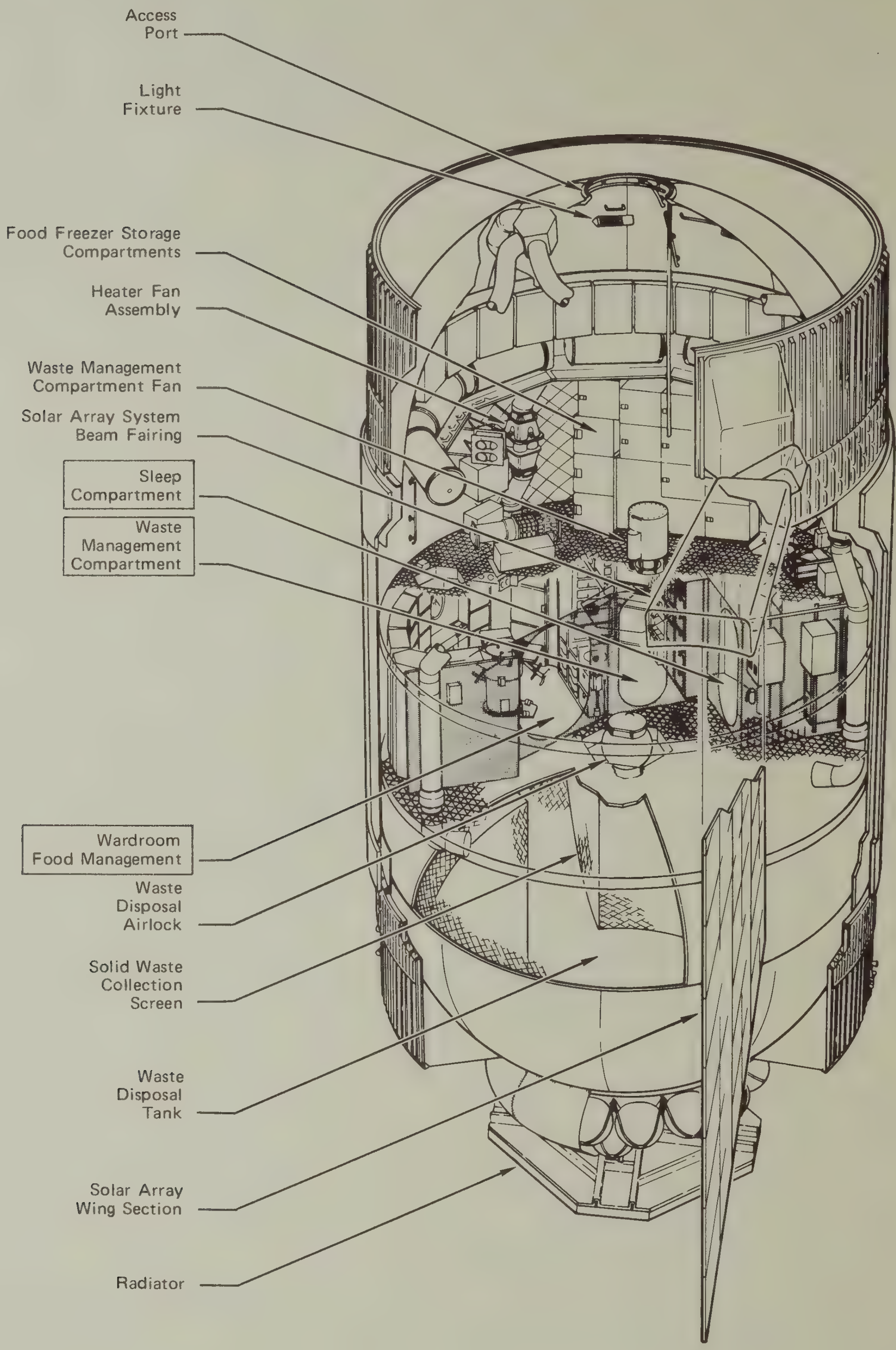
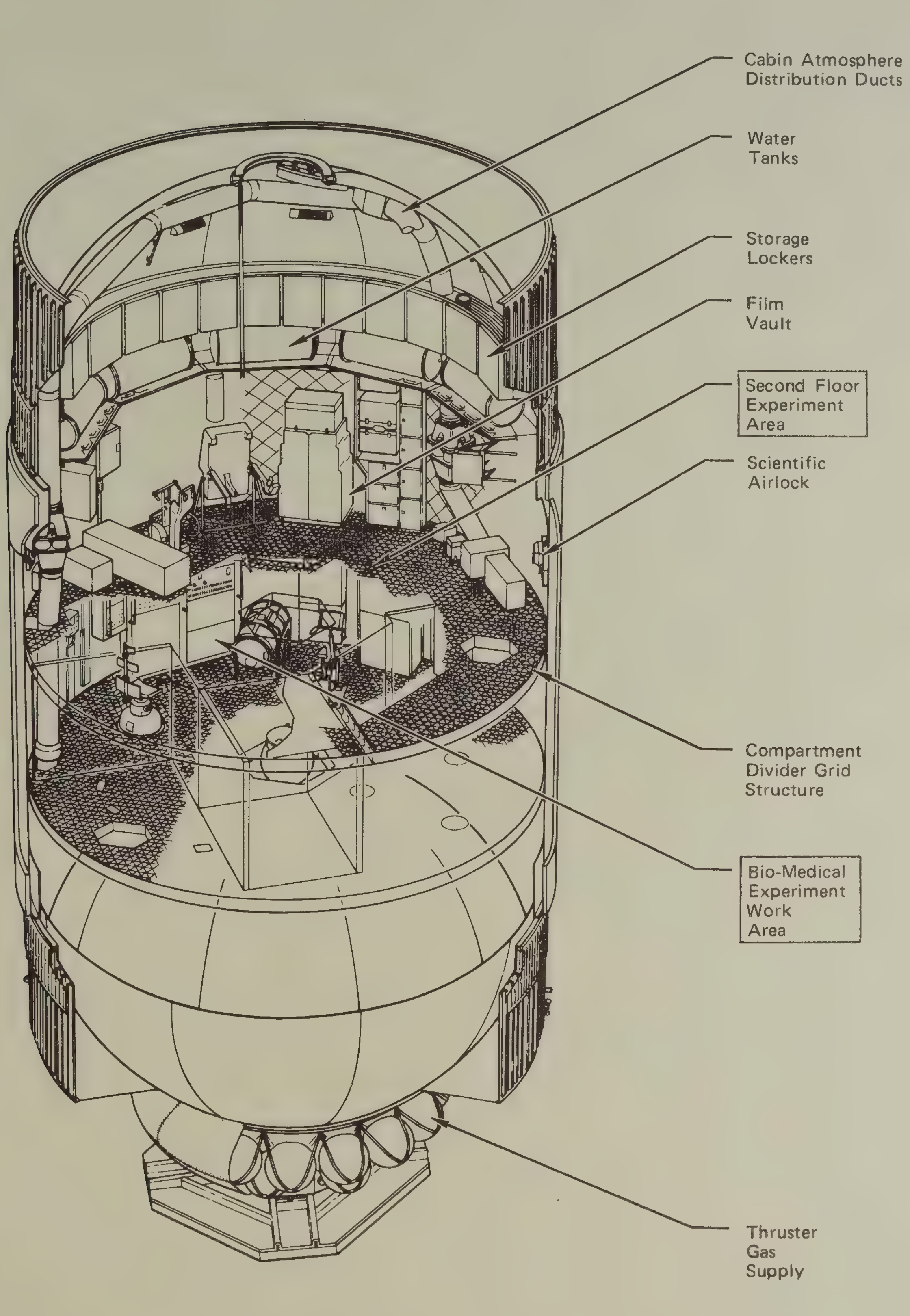


Figure 2-8. Orbital Workshop


Cabin Atmosphere
Distribution Ducts
Water
Tanks
Storage
Lockers
Film
Vault
Second Floor
Experiment
Area
Scientific
Airlock
Compartment
Divider Grid
Structure
Bio-Medical
Experiment
Work
Area
Thruster
Gas
Supply

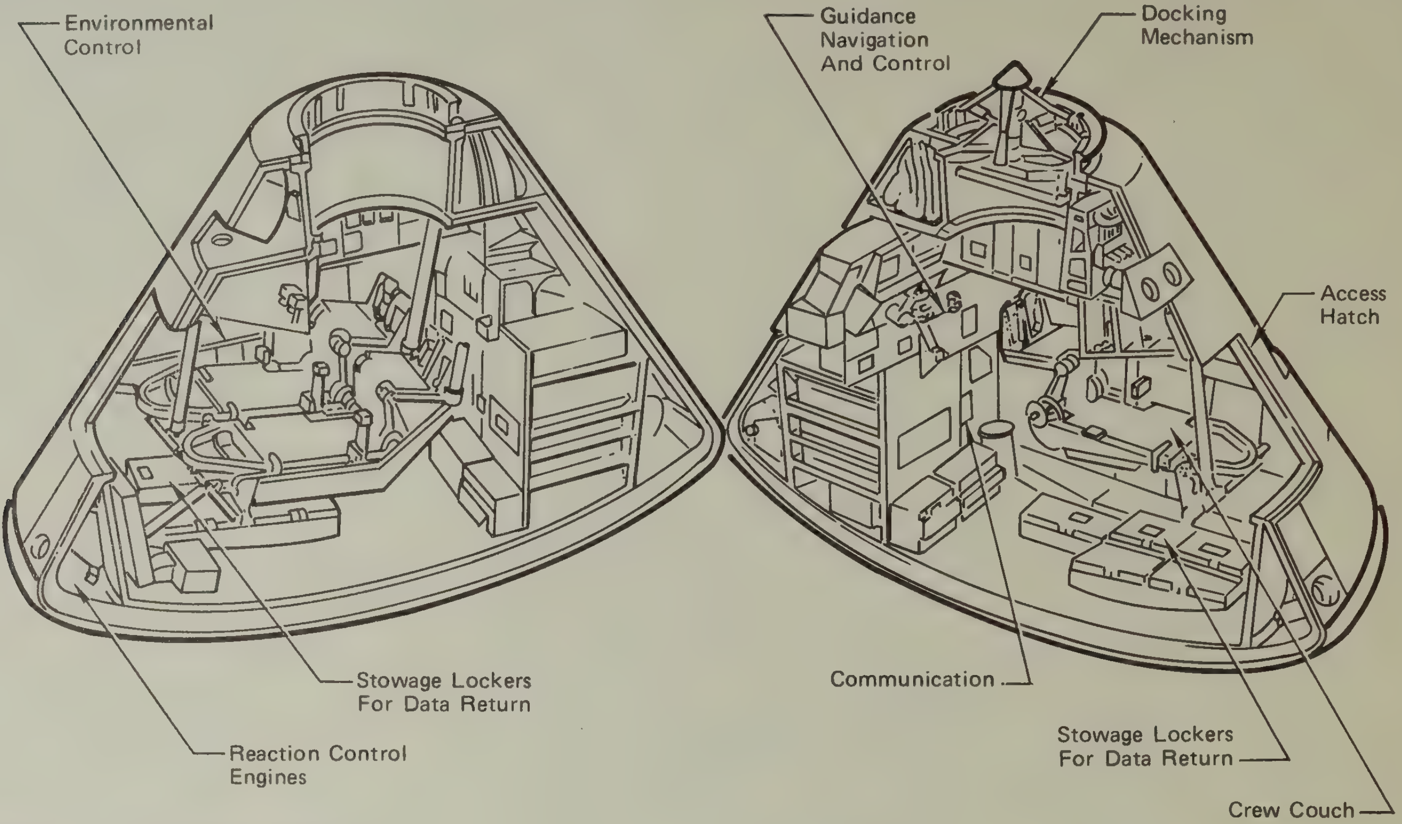


Figure 2-9. Command Module

Apollo Command and Service Module

The Apollo Command and Service Module (Figure 2-9), modified for an orbital life of 56 days, serves as the manned logistics spacecraft for the Skylab. When docked to the Skylab, the Command and Service Module, except for communications equipment, is powered down to a quiescent mode until required for return. The Command Module also provides for the stowage, resupply, and return of experiments and/or experiment data.

SKYLAB MISSION PROFILE AND OPERATIONS

The Skylab is launched by a single two-stage Saturn V. Three separate Saturn IB's launch the Command and Service Modules (Figure 2-10). The initial mission consists of two launches approximately one day apart. The first launch from Kennedy Space Center is the Skylab. Following insertion into an orbit of approximately 235 nmi altitude at an inclination of 50 degrees, the S-II stage is separated by retrorockets and the Skylab is rotated by the attitude control system to allow jettisoning the Payload Shroud. The Shroud provides environmental protection for the payload and supports the Apollo Telescope Mount during launch. The attitude control system begins to orient the Skylab to a solar-inertial attitude. The Apollo Telescope Mount is deployed. At this point in the activation sequence, the Apollo Telescope Mount and Workshop solar arrays are deployed to assure the availability of electrical power.

Before launching the first Command and Service Module, the Skylab is checked by ground command and telemetry data for operational conditions prior to the manned launch. The manned Command and Service Module will be launched by a Saturn IB vehicle and inserted into an 81 to 120 nmi phasing orbit. The Service Module propulsion and reaction control systems are then used to perform orbital transfer and rendezvous maneuvers to dock with the Skylab. The crew transfers to and activates the Skylab.

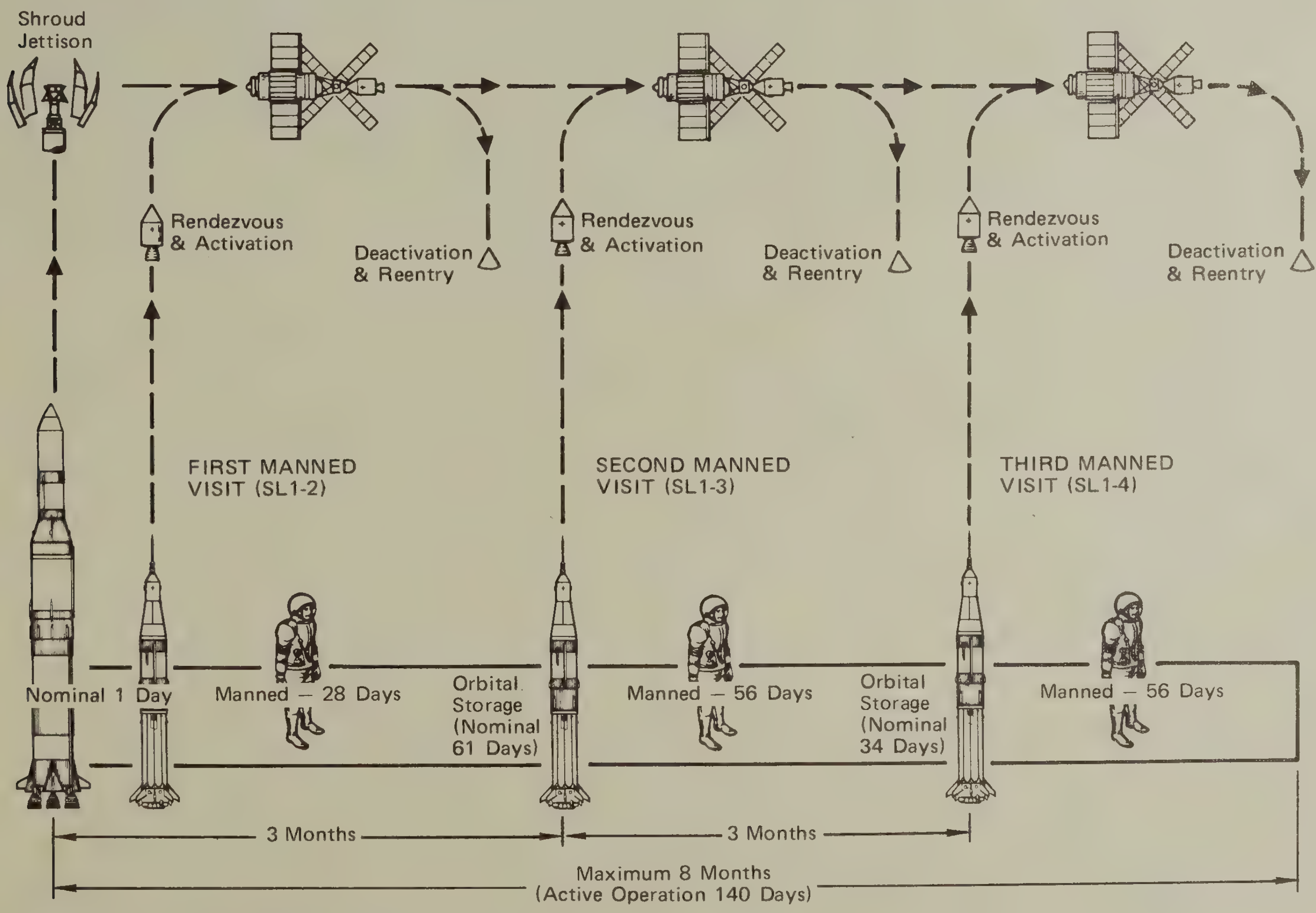


Figure 2-10. Skylab Mission Profile

The first manned mission includes a series of medical experiments for the evaluation of astronaut activity and physical condition during the conduct of the experiments. Experiment tasks include solar astronomy, Earth resources, and technical experiments. The 28 day mission will begin with the launch of the Command and Service Module. At completion of the scheduled mission, the Skylab will be prepared for the unmanned orbital phase and the Command and Service Module will undock from the Skylab and deorbit. Depending upon mission duration, recovery will occur in daylight in either the West-Atlantic or the Mid-Pacific recovery area. During the unmanned phase, the Skylab will be in a semiactive condition and will remain in the solar-inertial attitude.

The second manned Command and Service Module mission is launched approximately 90 days after the first manned launch. This mission will be for a duration of 56 days from launch. The mission purpose is to resupply selected items, continue specific experiments, and initiate new experiments. The third manned Command and Service Module mission will be launched 90 days after the second Command and Service Module launch. This mission is also planned for 56 days. It too will provide selected resupplies and the crew will complete the technical and scientific experiemnts. A set of replica vehicle and experiment hardware will be available at the launch site to ensure a backup for each mission segment.

After completion of the experiment and mission activities, the Skylab will be prepared for final orbital storage in the solar-inertial attitude. The Command and Service Module will undock from the Skylab and return to Earth. In total, the Skylab represents an opportunity to capitalize on 420 man-days of orbital experiment activities within an eight-month total mission duration.

Section 3
EXPERIMENT PROGRAM

The Skylab experiments will capitalize on the unique opportunities available in Earth orbit. The Earth resources and solar astronomy observations utilize the vantage point and disturbance free environment of orbital space for the investigator to make observations and measurements not possible from terrestrial or airborne observatories. The technology and operations experiments rely on special and unique properties of the space environment to examine phenomena, materials, processes and techniques. The medical investigations during the long 56 day missions will determine man's adaptability to changes in his normal environment.

In accomplishing these experiment objectives, more than 3,500 astronaut hours will be allocated to the performance of about 270 separate scientific and technological investigations. These investigations involve almost 600 identified principal investigators and co-investigators and more than 100 senior scientists through formal agreements with the principal investigators (see Table 1). Beyond this, there is a larger group who will assist in the analysis and interpretation of the results. Altogether, Skylab represents a substantial program in applied and basic sciences.

Another scientific dimension of the Skylab Experiment Program is found in the worldwide solar observations program. This will involve coordinating observations from the ground with those from the Skylab in orbit. Similarly there is a very broad program of data acquisition from ground stations, aircraft and the Earth Resources Technology Satellite for correlation with the information gathered by the Skylab Earth Resources Experiment Package sensors.

The importance of the Skylab Research Program is highlighted in the following descriptions:

EARTH RESOURCES

Remote Earth observations from space have the potential of becoming a fundamental technique in effective use and conservation of natural resources, and in better understanding and managing interacting influences between man and his natural environment.

Photography from Earth orbital spacecraft has proven valuable for mapping geographic and weather features over large areas of the Earth. Systematic application of other remote sensing techniques may extend the usefulness of this capability to mapping of Earth resources and land uses. Resources amenable to this type of study include identification of crops and ground cover, vegetation vigor, soil types, snow pack and water storage, surface or near-surface mineral deposits, sea surface temperature and roughness, the location and migration of fish stock, etc.

Development of remote sensing techniques in extended spectral ranges at altitudes up to 60,000 feet is already a part of the NASA Aircraft Program. Aerial reconnaissance of ground truth sites is being conducted to test measuring techniques, to validate interpretive techniques and to ascertain the

dependability of recognizable spectral signatures. Development has reached the point where remote sensing has been used operationally to assist in pinpointing forest fires through dense smoke cover and in mapping corn blight damage.

Space tests of remote sensing techniques have also been conducted during the Mercury, Gemini and Apollo programs with increasing degrees of sophistication. Several thousand high quality photographs obtained have been effectively used in many disciplines. Apollo missions added haze filters, demonstrated photography in the visible and infrared wavelengths, overlap photography for stereo viewing, and photography of ground test sites.

The Skylab Earth Resources Experiment Package (EREP) is the most recent step in this important aspect of understanding and managing the Earth/man relationship. EREP will improve on the Apollo visible light and infrared photography and will, in addition, include electronic infrared spectrography and microwave radar and radiometry surveys.

EREP photographic equipment and techniques will greatly improve resolution of Earth resources phenomena by simultaneous exposures using six matched cameras and by precise photometry that can provide more accurate light intensity levels in each survey photograph. The infrared spectrography survey will operate in wavelengths not recordable on photographic film and will provide data for plotting recognizable spectral signatures of the observed phenomena. The EREP microwave radar and radiometry equipment has a low sensitivity to atmospheric moisture and will provide an all-weather source of information on surface moisture, temperature and vegetation distribution. Microwave radiometry over the oceans will provide information on wind and sea conditions on a global scale.

SOLAR OBSERVATIONS

A systematic study of the Earth and its environment would not be complete without detailed study of the Sun. All life on Earth is dependent on the radiation from the Sun received through the atmosphere on land and sea. Variations in the amount and character of the solar radiation reaching the Earth suggest influences that solar cycles have on weather, communications and the terrestrial environment in general. The Skylab experiment program has a major segment devoted to solar studies.

Skylab, and in particular the Apollo Telescope Mount (ATM), will carry a 2,000 pound scientific payload of eight instruments specifically tailored to an observation program of the Sun. It constitutes a significant step into the future by combining capabilities (1) to conduct astronomical research from space removed from the optical and mechanical disturbances evident on Earth, and (2) to have man operate complex equipment with the attendant flexibility and adaptability of the man-machine design. This combination will permit an astronaut trained in the science of astronomy to enhance the achievements possible with large scientific instruments in space.

The ATM instruments are larger and more sensitive than any previously flown in space. Solar astronomers, in this country and abroad, will utilize these instruments along with ground-based instruments for an all-out national and international effort to study the Sun in 1973. All ATM instruments will observe the same spot on the Sun simultaneously. The astronaut will select the most interesting region on the Sun by looking at television displays of the Sun as it can be seen only from space – in ultraviolet light and in X-rays. The scientists conducting the experiments have jointly identified the most important problems that can be addressed with ATM.

PHYSICAL SCIENCES

Earth is a spacecraft in orbit about the Sun. It is surrounded by a near-Earth environment, the atmosphere, which is crucial to the maintenance of life on Earth. The atmosphere in turn is surrounded by a near-vacuum called space which is environmentally hostile to life. Increased understanding of the balance between the hostility of space and the atmospheric protection of Earth is the purpose of the physical science experiments on Skylab.

In addition to an extensive solar study, Skylab will carry physical science experiments to investigate (1) the contribution of deep space (beyond our solar system) to Earth's environment, (2) the characteristics of the Earth's upper atmosphere, and (3) the content of the medium directly surrounding Skylab.

LIFE SCIENCES

The Skylab biomedical program is a study of normal, healthy men and their reactions in an environment where the effects of gravity, one of Earth's key environments, has been nullified. From this study, a great deal can be learned about gravity's importance to man's physiological functions.

Previous studies of man exposed to zero gravity observed a consistent loss of body fluid; a small loss in bone calcium and muscle mass; and a reduction in the ability of blood vessels to actively distribute blood to the various parts of the body following return to an Earth gravity condition. These effects disappeared a few days after returning to Earth and so far have shown no consistent relationship with the time spent in zero gravity. Similar effects have been observed in individuals confined to prolonged bed rest on Earth.

Skylab will allow an evaluation of these and other phenomena under prolonged zero gravity conditions using more rigorous evaluation techniques. Typically the human biomedical experiment program consists of investigations such as the effect of gravity on nutritional requirements, man's metabolic effectiveness in doing mechanical work, the effects of exposure to zero gravity on the heart and blood vessels, the role of gravity on man's psychomotor efficiency in the performance of useful tasks, and the effect of gravity on the senses governing balance, orientations and motion.

TECHNOLOGY AND OPERATIONS EXPERIMENTS

These experiments are related to improving manned operations in space and space technology.

The manned operation of Skylab-A will provide information on the suitability of the living conditions and crew accommodations. The crews will evaluate the size, shape, ease of use, comfort, and appearance of the spacecraft interior and equipment. This information base will provide the "architectural concepts" of future manned spacecraft. A valuable part of these observations will be the crew's subjective likes and dislikes. An example of this, is the sense of roominess that weightlessness appears to induce, with its capability of multidirectional orientation.

Zero gravity introduces new approaches to astronaut mobility. Within the spacecraft, movement from one area to another can be achieved by floating. Outside the spacecraft the same form of movement is possible, but, inconvenient, and without a restraining tether is hazardous. Movement along the outside of the spacecraft is possible by using handholds, but movement from one spacecraft to another requires more sophisticated maneuvering equipment which will be tested within the large experiment compartment in the workshop.

Closely associated with the freedom of travel afforded by zero gravity is the sensitivity of the orbiting spacecraft to disturbances caused by crew motion inside it. Skylab experiments will evaluate the magnitude of this effect.

Manufacturing techniques not possible on Earth may be possible in zero gravity. The casting of spheres, growth of crystal structures and organisms, development of foamed high strength materials are some of the space manufacturing technology concepts to be studied in Skylab. These experiments may lead to practical uses of space for processing a variety of materials.

At Skylab's orbital altitude, the radiation environment differs greatly from that on Earth. The radiation approaching Earth is captured by Earth's magnetic field and forms belts whose inner surfaces are some 250 to 300 miles above Earth. These belts are known as the Van Allen Belts. Over one part of the Earth's surface traversed by Skylab (the South Atlantic), this belt dips low enough for Skylab to pass through. The radiation levels in this South Atlantic Anomaly will be measured and the cumulative effects determined.

The following table lists the principal investigator and their respective experiments which currently comprise the Skylab-A Experiment Program. Also shown are the flight assignments which will be activated and data retrieved.

Table 1. Skylab-A Experiments Program Principal Investigators

PRINCIPAL INVESTIGATOR	TITLE	ACTIVE IN FLIGHTS SL-2	SL-3	SL-4
	EARTH RESOURCES			
Dr. T. Barnett, MSC	Infrared Spectrometer	X	X	X
Mr. K. Demel, MSC	Multispectral Photography	X	X	X
Dr. D. Evans, MSC	L-Band Radiometer	X	X	X
Dr. D. Evans, MSC	Microwave Radiometer/ Scatterometer/Altimeter	X	X	X
Dr. C. Korb, MSC	Multispectral Scanner	X	X	X
	SOLAR OBSERVATIONS			
Dr. R. Giacconi, American Science & Engineering, Cambridge	X-Ray Spectrographic Telescope	X	X	X
Dr. L. Goldberg, Harvard Observ., Cambridge	UV Scanning Polychromator/ Spectroheliometer	X	X	X
Dr. R. MacQueen, High Altitude Observ., Boulder, Colo.	White Light Coronagraph	X	X	X
Mr. J. Milligan, MSFC	X-Ray Telescope	X	X	X
Dr. R. Tousey, USN Research Lab	UV Coronal Spectroheliograph	X	X	X
Dr. R. Tousey, USN Research Lab	UV Spectrograph	X	X	X
Dr. R. Tousey, USN Research Lab	X-Ray, UV Solar Photography	X	X	X
	PHYSICAL SCIENCES			
Dr. G. Courtes, Laboratoire d'Astronomie, Spatiale, France	Ultraviolet Panorama	X	X	
Dr. J. Geiss, Univ of Bern, Switzerland	Magnetospheric Particle Composition		X	
Dr. G. Guenther, Univ of Ala., Huntsville	Proton Spectrometer	X	X	X
Dr. C. Hemenway, Dudley Observatory	Particle Collection		X	
Drs. K. Henize, MSC; J. Wray, Northwestern Univ	UV Stellar Astronomy	X	X	
Dr. W. Kraushaar, Wisconsin Univ	Galactic X-ray Mapping			X
Dr. D. Lind, MSC	Magnetospheric Particle Composition		X	
Dr. D. Packer, USN Research Lab	UV Airglow Horizon Photography		X	
Dr. B. Price, Univ of California	Transuranic Cosmic Rays	X	X	X
Dr. M. Shapiro, USN Research Lab	Nuclear Emulsion	X		
Dr. J. Weinberg, Dudley Observatory	Gegenschein/Zodiacal Light	X	X	X
	LIFE SCIENCES			
Capt. N. Allebach Naval Aerospace Medical Institute	Vectorcardiogram	X	X	X
Dr. J. Frost, Baylor School of Medicine	Sleep Monitoring	X	X	
Dr. A. Graybiel, Mr. E. Miller, USN Aerospace Medical Institute	Human Vestibular Function	X	X	
Dr. P. Johnson, Baylor	Blood Volume, Red Cell Life Span	X	X	X
Dr. R. Johnson, MSC	Lower-Body Negative Pressure	X	X	X
Dr. S. Kimzey, MSC	Special Hematologic Effects	X	X	X
Dr. J. Kubis, Fordham Univ	Time and Motion Study	X	X	X
Dr. C. Leach, MSC	Bioassay of Body Fluids	X	X	X
Dr. R. Lindberg, Northrop Corp.	Circadian Rhythm, Vinegar Gnat		X	

Table 1. Skylab-A Experiments Program Principal Investigators (Continued)

PRINCIPAL INVESTIGATOR	TITLE	ACTIVE IN FLIGHTS SL-2	SL-3	SL-4
LIFE SCIENCES (CONTINUED)				
Dr. L. Lockhart, Univ of Texas	Cytogenetic Studies of Blood	X	X	X
Dr. C. Mengel, Missouri Univ	Red Blood Cell Metabolism	X	X	X
Mr. E. Michel, MSC	Metabolic Activity	X	X	X
Dr. P. Montgomery, Dallas County Hospital	Effects of Zero G on Human Cells	X		
Dr. C. Pittendrigh, Stanford Univ	Circadian Rhythm, Vinegar Gnat		X	
Dr. S. Ritzmann, Univ of Texas	Man's Immunity — In Vitro Aspects	X	X	X
Dr. W. Thornton, MSC	Body Mass Measurement	X	X	X
Dr. W. Thornton, MSC	Specimen Mass Measurement	X	X	X
Dr. J. Vogel, U.S. Public Health Service	Bone Mineral Measurement	X	X	
Dr. G. Whedon, National Institute of Health	Mineral Balance	X	X	X
TECHNOLOGY AND OPERATIONS				
Mr. A. Boese, MSFC	Multipurpose Electric Furnace System			X
Mr. R. Bond, MSC	Crew Activities, Maintenance	X	X	X
Dr. B. Conway, LaRC	Crew Vehicle Disturbances			X
Dr. A. Deruytherre, Catholic Univ, Belgium	Silver Grids Melted in Space			X
Dr. H. Gatos, MIT	Indium Antimonide Crystals			X
Dr. M. Greenberg, Dudley Observatory	Coronagraph Contamination Measurement	X		
Capt. A. Grimm, USAF	Radiation in Spacecraft	X		
Mr. E. Hasemeyer, MSFC	Copper-Aluminum Eutectic			X
Mr. E. Hasemeyer, MSFC	Sphere Forming	X		
Mr. D. Hewes, LaRC	Foot-Controlled Maneuvering Unit		X	
Mr. C. Johnson, MSC	Habitability/Crew Quarters	X	X	X
Dr. T. Kawada, National Research Institute, Japan	Whisker-Reinforced Composites			X
Mr. H. Kimzey, MSC	Zero G Flammability			X
Dr. W. Leavitt, U.S. Dept of Transportation	Inflight Aerosol Analysis	X	X	X
Dr. W. Lehn, WPAFB	Thermal Control Coatings	X	X	
Mr. E. McKannan, MSFC	Thermal Control Coatings	X	X	X
Dr. J. Muscari, Martin Marietta Corporation	ATM Contamination Measurement	X	X	X
Dr. F. Padovani, Texas Instr.	Microsegregation in Germanium			X
Mr. G. Parks, MSFC	Materials Processing Space	X		
Mr. R. Poorman, MSFC	Metals Melting	X		
Dr. R. Randle, ARC	Manual Navigation Sightings		X	
Mr. J. Reger, TRW	Immiscible Alloy Compositions			X
Dr. M. Rubenstein, Westinghouse	Gallium Arsenide Crystal Growth	X		
Dr. A. Ukanwa, MSFC	Radioactive Tracer Diffusion			X
Dr. H. Walter, Univ of Ala., Huntsville	Growth of Spherical Crystals			X
Maj. C. Whitsett, USAF	Astronaut Maneuvering Equipment	X	X	
Dr. H. Wiedemeier, Rensselaer Polytechnic Inst., N.Y.	Vapor Growth of II-VI Compounds			X
Dr. W. Wilcox, USC	Mixed III-V Crystal Growth			X
Mr. J. Williams, MSFC	Exothermic Brazing	X		
Dr. A. Yue, UCLA	Metal and Halide Eutectics			X

STUDENT SCIENCE EXPERIMENTS

The selection of 25 national finalists in the Skylab Student Project was made by the National Science Teachers Association and NASA. A number of these experiments and demonstrations proposed by high school students will be conducted. Proposals by the 25 finalists were chosen from entries submitted by high school students across the nation and overseas (see Table 2). The Project is designed to stimulate student and teacher interest in space science and technology by directly involving high school students in space-based research.

Table 2. National Science Teachers Association (NSTA) Skylab Student Project Finalists

STUDENT NAME	EXPERIMENT TITLE	HIGH SCHOOL
	EARTH RESOURCES	
Troy A. Crites	Space Observation and Prediction of Volcanic Eruptions	Kent Junior High School Kent, Washington
Joe B. Zmolek	Earth's Absorption of Radiant Heat	Lourdes High School Oshkosh, Wisconsin
	ASTRONOMY	
Daniel C. Bochsler	Possible Confirmation of Objects Within Mercury's Orbit	Silverton Union High School Silverton, Oregon
John C. Hamilton	Spectrography of Selected Quasars	Aiea High School Aiea, Hawaii
Alison Hopfield	Photography of Libration Clouds	Princeton Day School Princeton, New Jersey
Jeanne L. Leventhal	X-Ray Emission from the Planet Jupiter	Berkeley High School Berkeley, California
Joe W. Reihs	X-Ray Content in Association with Stellar Spectral Classes	Tara High School Baton Rouge, Louisiana
Neal W. Shannon	A Search for Pulsars in Ultraviolet Wavelengths	Fernbank Science Center Atlanta, Georgia
	BACTERIOLOGY	
Todd A. Meister	An In-Vitro Study of Selected Isolated Immune Phenomena	Bronx High School of Science Jackson Heights, New York
Robert L. Staehle	Behavior of Bacteria and Bacteria Spores in the Skylab and Space Environment	Harley School Rochester, New York
Keith L. Stein	Effects of Intermittent Long Duration Exposure to Zero and Artificial Gravity	W. Tresper Clarke High School Westbury, New York
	PHYSIOLOGY	
Kathy L. Jackson	A Quantitative Measure of Motor Sensory Performance During Prolonged In-Flight Zero Gravity	Clear Creek High School Houston, Texas

Table 2. National Science Teachers Association (NSTA) Skylab Student Project Finalists (Continued)

STUDENT NAME	EXPERIMENT TITLE	HIGH SCHOOL
	BOTANY	
Cheryl A. Peltz	Cytoplasmic Streaming in Zero Gravity	Arapahoe High School Littleton, Colorado
Donald W. Schlack	Phototropic Orientation of an Embryo Plant in Zero Gravity	Downey High School Downey, California
Joel G. Wordekemper	Plant Growth in Zero Gravity	Central Catholic High School West Point, Nebraska
	PHYSICS	
Vincent W. Converse	Zero Gravity Mass Measurement	Harlem High School Rockford, Illinois
W. Brian Dunlap	Wave Motion Through a Liquid in Zero Gravity	Austintown Fitch High School Youngstown, Ohio
James E. Healy	Universal Gravitational Constant: Determination in Space	St. Anthony's High School Bayport, New York
Roger G. Johnston	Capillary Studies in a State of Free Fall	Alexander Ramsey High School St. Paul, Minnesota
Keith D. McGee	Effect of Zero Gravity on the Colloidal State of Matter	South Garland High School Garland, Texas
Gregory A. Merkel	Brownian Motion and Dissolution of a Salt in Zero Gravity	Wilbraham and Monson Academy Springfield, Massachusetts
Terry G. Quist	Earth Orbital Neutron Analysis	Thomas Jefferson High School San Antonio, Texas
Kirk M. Sherhart	Testing Flow Properties of Powdered Solids in Zero Gravity	Berkley High School Berkley, Michigan
	ZOOLOGY	
Kent M. Brandt	Chicken Embryology in Zero Gravity	Grand Blanc Senior High School Grand Blanc, Michigan
Judith S. Miles	Web Formation in Zero Gravity	Lexington High School Lexington, Massachusetts

Section 4
SKYLAB – ROLES AND RESPONSIBILITIES

The management and development of the Skylab-A program has involved a broad segment of the National Aeronautics and Space Administration and the aerospace industry. The following brief descriptions identify the primary organizations and their principal participation.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OFFICE OF MANNED SPACE FLIGHT – Washington, D.C. The Skylab Program Office is responsible for directing, integrating, and evaluating all phases of Skylab to ensure the success of each flight mission and the program as a whole. The organization provides for the execution of overall functional responsibilities in the areas of experiments, program integration and control, test, reliability, quality and safety, systems engineering, and operations.

MARSHALL SPACE FLIGHT CENTER – Huntsville, Alabama. MSFC has program management responsibility for:

- *Developing Skylab elements including the Orbital Workshop, Airlock Module, Multiple Docking Adapter, Apollo Telescope Mount, and the payload shroud.*
- *Developing assigned experiments and supporting hardware.*
- *Integrating assigned experiments and support systems into the Skylab flight hardware.*
- *Overall systems engineering and integration to assure the compatibility and integration of the complete mission hardware for each flight.*
- *Flight evaluation/Flight support.*

MSFC is also responsible for providing the Saturn IB and Saturn V launch vehicles and for making any required vehicle modifications.

MANNED SPACECRAFT CENTER – Houston, Texas. MSC has responsibility for:

- *Development of the modified Command and Service Modules.*
- *Development of the Spacecraft Launch Adapter (SLA) for manned launches.*
- *Development of assigned experiments, crew systems, medical equipment, food, and other crew supporting hardware.*
- *Integrating experiments to be carried in the Apollo spacecraft and providing for stowage of experiment data and hardware designated for return from orbit.*
- *Mission analysis, including mission requirements development, detailed mission flight planning and preflight preparations.*
- *Providing and training flight crews.*
- *Accomplishment of all biomedical and earth resources experiments.*
- *Planning and executing mission control, flight operations, and recovery activity.*
- *Mission evaluation.*

KENNEDY SPACE CENTER – Florida. KSC has responsibility for:

- *Providing launch facilities for Flights SL-1 through SL-4.*
- *Preparing checkout procedures and accomplishing the prelaunch checkout.*
- *Planning and executing launch operations.*

MAJOR SKYLAB PROGRAM CONTRACTORS

MCDONNELL DOUGLAS CORPORATION is responsible for the design, development, fabrication, equipment installation, testing, and checkout of the Orbital Workshop and the Airlock Module. Included in these modules are the prime environmental control system and portions of the electrical, communications, and data-handling systems.

The Company is responsible for providing habitable living quarters for the astronauts in the Orbital Workshop. This involves the interior arrangement and design of the living and work areas and responsibility for the sleeping, eating, and personal hygiene facilities. In addition, MDC has responsibility for the Payload Shroud and the Deployment Assembly for the Apollo Telescope Mount.

MARTIN MARIETTA CORPORATION'S role includes overall Skylab cluster systems engineering analysis and integration of the payload, definition and evaluation of the interfacing of the Skylab modules, support of crew operations, management of assigned experiments, and Multiple Docking Adapter modifications, equipment installation, and checkout.

Experiment responsibilities include design and development of the control and display panel, the Viewfinder/Tracking Subsystem, and other equipment for the earth resources experiments. Development and production of the ATM solar observatory control and display console is done by The Bendix Corporation under contract to Martin Marietta.

NORTH AMERICAN ROCKWELL CORPORATION is responsible for modifying the Apollo Command and Service Module to meet the requirements of the Skylab Program. These modifications are required to extend the life of the spacecraft to 56 days while docked to Skylab. NAR has design, development, production, testing, and checkout responsibility for the basic Apollo spacecraft and the modifications required for Skylab.

MAJOR LAUNCH VEHICLE PROGRAM CONTRACTORS

BOEING COMPANY is responsible for the production of the first stage of the Saturn V launch vehicle. This stage was produced by Boeing at the NASA Michoud Assembly Facility and at the Mississippi Test Facility located near New Orleans, Louisiana. Also responsible for the Saturn V vehicle integration and launch support.

CHRYSLER CORPORATION is responsible for the production of the first stage of the Saturn IB launch vehicle and for the Saturn IB vehicle integration and launch support. The production was also accomplished at the NASA Michoud Assembly Facility.

MCDONNELL DOUGLAS CORPORATION developed and produced the upper stage for both the Saturn V and the Saturn IB launch vehicles.

NORTH AMERICAN ROCKWELL CORPORATION developed and manufactured the second stage of the Saturn V. NAR also developed and produced the liquid rocket engines used in the various stages of the Saturn V launch vehicle.